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User Guide for the Fault Tree and Damage Assessment List Utility

by TraNese S. Christy

ARL-TN-234 **February 2005**

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14. ABSTRACT
The Fault Tree and Damage Assessment List (FTD) utility is designed to assist in the development of criticality analyses. It provides an interactive graphical user interface for the construction, editing, and viewing of deactivation diagrams (fault trees) and damage assessment lists. This document is a functional description of FTD.

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1. Introduction

1.1 Background

The Fault Tree and Damage Assessment List (FTD) utility is designed to assist in the development of criticality analyses. It provides an interactive graphical user interface (GUI) for the construction, editing, and viewing of deactivation diagrams (fault trees) and damage assessment lists (DAL). It also provides checking and debugging capabilities to ensure completeness and consistency of analyses. FTD includes full support for the Fault Tree Markup Language (FTML) format.[1] This document is a functional description of FTD.

1.2 Basic Elements and GUI

FTD runs on UNIX, Mac OS X, and Windows 2000 platforms. Thus, the appearance and behavior of the utility vary slightly from platform to platform. (Note that graphics in this document were generated on a computer running RedHat Linux 9.) As shown in figure 1, there are two views (distinguished by the tabs labeled "DAL" and "Fault Tree") in which to work. The DAL view displays a table where the loss of function of a vehicle can be specified. The Fault Tree view, which is the focus of this document, is divided into two areas. On the left, there is an editing window in which fault trees are constructed, edited, or viewed. On the right, there is a list of the systems that have been created. The active system, which is the diagram that appears in the editing window, is highlighted in blue.

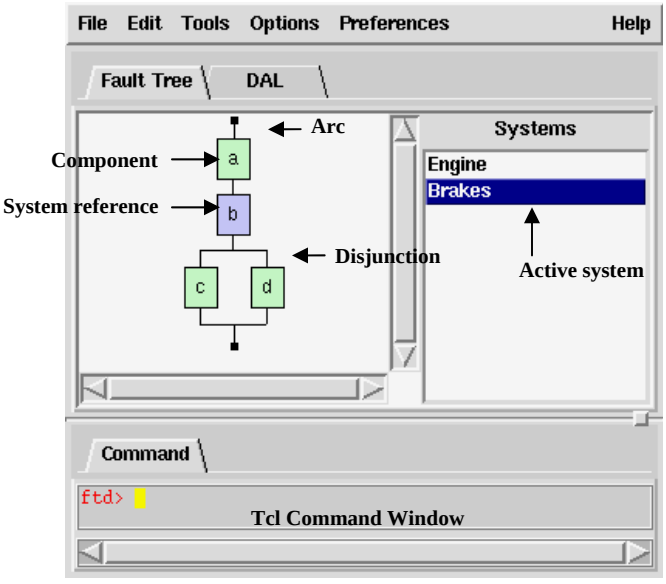

Figure 1. Example deactivation diagram.

[1] Saucier, R. *Fault Tree Representation and Evaluation*; ARL-TR-2923; U.S. Army Research Laboratory: Aberdeen Proving Ground, MD, 2003.

The utility's menu bar, located at the top of the window, offers a number of menus to include File, Edit, Tools, Options, Preferences and Help. These menus are explained in detail in the following sections. In the bottom portion of the GUI, there is a Tool Command Language (Tcl) Command Window in which Tcl commands can be evaluated.*

As shown in figure 1, the basic elements in a system or fault tree are arcs, components, system references, and disjunctions. The definitions for each are as follows:

- Arc – a vertical connecting line used to connect elements in a series path.
- Component – a box representing a critical component within a system.
- System reference – a box representing a system without displaying the fault tree.
- Disjunction – a set of parallel paths.

Each of the basic elements has a pop-up menu associated with it. These menus are described in section 2.

2. Pop-Up Menus

The basic elements (arc, component, system reference, and disjunction) and the active system have commands that can be applied to them and are made available through pop-up menus. Each of these menus and the associated commands are explained in the following sections.

2.1 Arc Menu

The arc menu, which is activated by right-clicking on an arc, provides commands to perform operations on the selected arc (see figure 2). Descriptions of the commands follow:

- Paste – inserts the clipboard contents (i.e., copied or deleted objects) into the diagram. This command will be nonselectable if no objects have been copied or deleted.
- New – creates a new object (component, system reference, or disjunction).
- Properties – outputs internal coding information used by developers.

* For additional information on Tcl, see Ousterhout, J. K. *Tcl and the Tk Toolkit*. Addison-Wesley: Reading, MA, 1994.

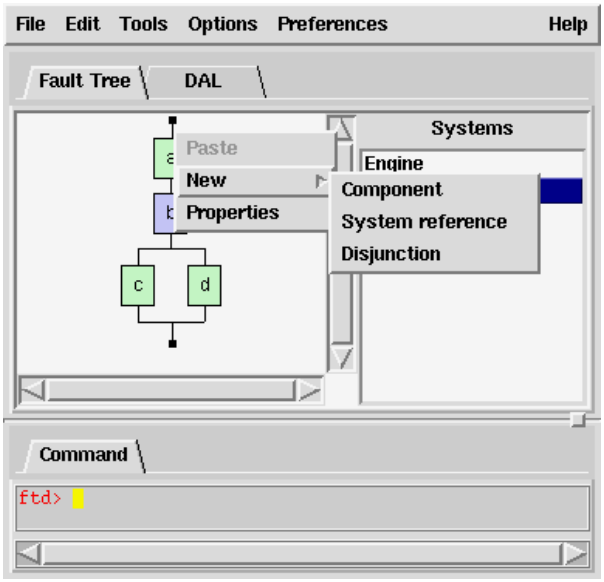

Figure 2. Arc menu.

2.2 Component Menu

The component menu, which is activated by right-clicking inside of a component, provides commands to perform operations on the selected component (see figure 3). Descriptions of the commands follow:

- Copy – copies the component to the clipboard.
- Delete – deletes the component from the diagram and moves it to the clipboard.
- Rename – assigns a new name to the component.
- Set fill color – sets the background color of the component.
- Set outline color – sets the color of the outline for the component.
- Font style – sets the style of the font for the component name (e.g., bold, italic, underline, and overstrike).
- Properties – outputs internal coding information used by developers.

	The clipboard feature in this utility is a temporary data storage area in which the most recently copied or deleted object is stored. It is comparative to the clipboard in popular desktop publishing applications. However, the Delete command in FTD functions like the Cut command in other applications. It removes an object from the diagram and transfers it to the clipboard. The object can then be pasted elsewhere in a diagram.

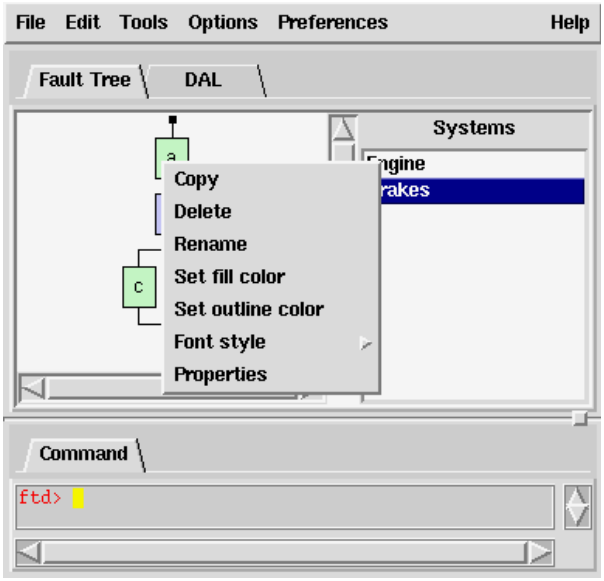

Figure 3. Component menu.

2.3 System Reference Menu

The system reference menu, which is activated by right-clicking inside of a system reference, provides commands to perform operations on the selected system reference (see figure 4). By default, a system reference is a light blue-purple color. If a system and the corresponding system reference (they have the same name) have been created in the same file, the system reference will be a dark blue-purple color. Descriptions of the menu commands follow:

- Raise – makes the system that corresponds to the selected system reference the active system. This command will be unavailable if the corresponding system has not been created in the current file.
- Copy – copies the system reference to the clipboard.
- Delete – deletes the system reference from the diagram and moves it to the clipboard.
- Rename – assigns a new name to the system reference.
- Set fill color – sets the background color of the system reference.
- Set outline color – sets the color of the outline for the system reference.
- Font style – sets the style of the font for the system reference.
- Properties – outputs internal coding information used by developers.
- Show DAL – makes the DAL view the active view if there is a corresponding entry in the DAL view.

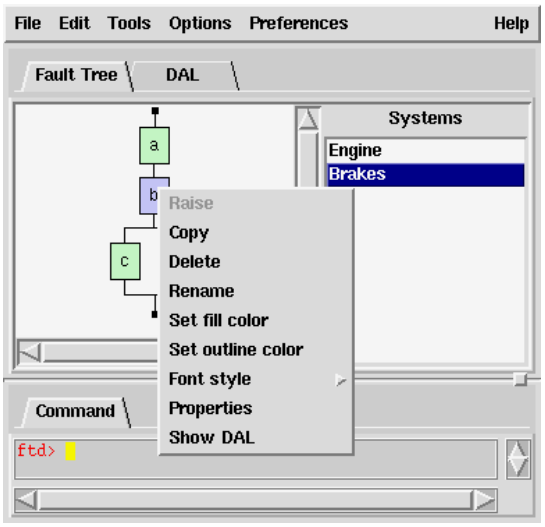

Figure 4. System reference menu.

2.4 Disjunction Menu

The disjunction menu, which is activated by right-clicking on either of the horizontal lines associated with a disjunction, provides commands to perform operations on the selected disjunction (see figure 5). Descriptions of the commands follow:

- Add a path – adds a path to the right side of the selected disjunction.
- Copy – copies the entire disjunction to the clipboard.
- Delete – deletes the disjunction from the diagram and moves it to the clipboard.
- Delete a path – deletes the specified path (paths are numbered in ascending order from left to right). The deleted path will not be moved to the clipboard.
- Properties – outputs internal coding information used by developers.

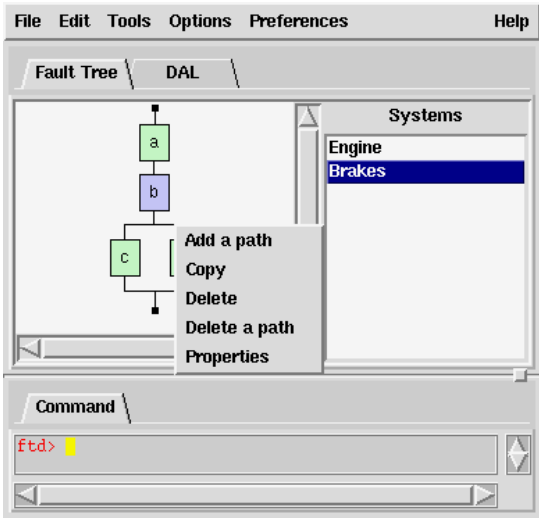

Figure 5. Disjunction menu.

2.5 Background Menu

The background menu, which is activated by right-clicking on the white background in the editing window, provides commands to perform operations on the active system (see figure 6). Descriptions of these commands follow:

- Clear system – deletes all objects from the active system without moving them to the clipboard.
- Redraw – refreshes the display of the active system.

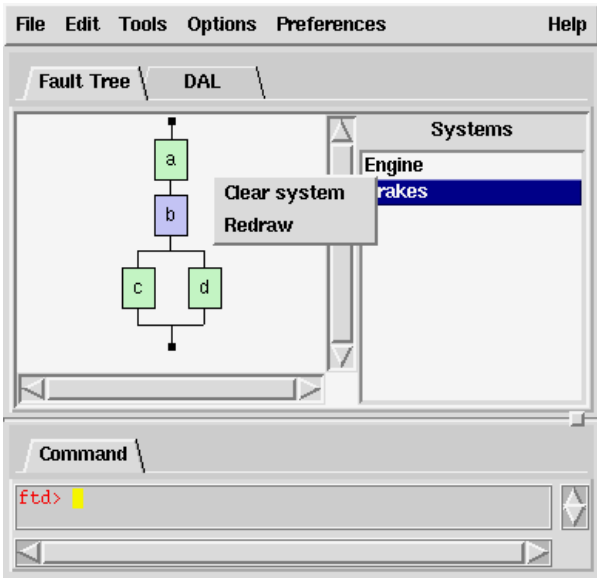

Figure 6. Background menu.

3. Edit Menu

The primary purpose of the Edit menu is to create systems. To create a system, the user needs to select "Create a system" from the Edit menu (see figure 7) and enter the name of the system.* An arc will be drawn in between a starting and an ending marker. The user must right-click on the arc to activate the arc menu. The user should then select "New" from this menu and choose which type of object to create and enter in the requested information (name or number of paths). The object will be drawn at the position where the user right-clicked originally. The steps used to create this object should be repeated until the fault tree is completed.

* System, component, and system reference names should not contain parentheses () or square brackets []. In addition, system names should not be exclusively numbers.

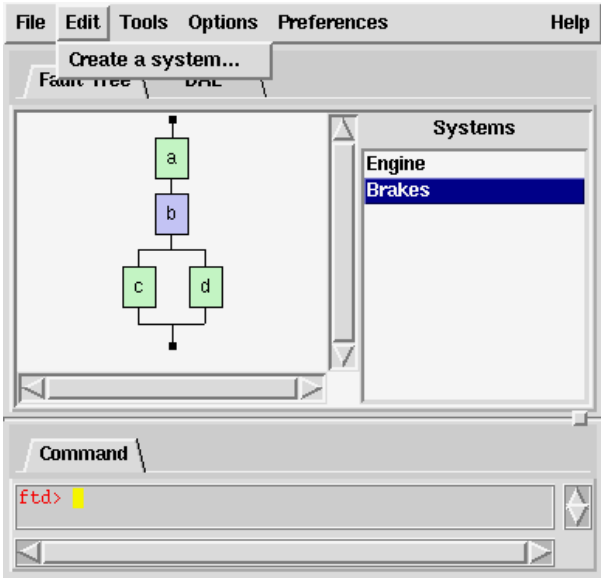

Figure 7. Edit menu.

4. File Menu

The File menu provides the following commands: Open, Import, Export, Save, Close, and Exit. These commands are explained in detail in the following sections.

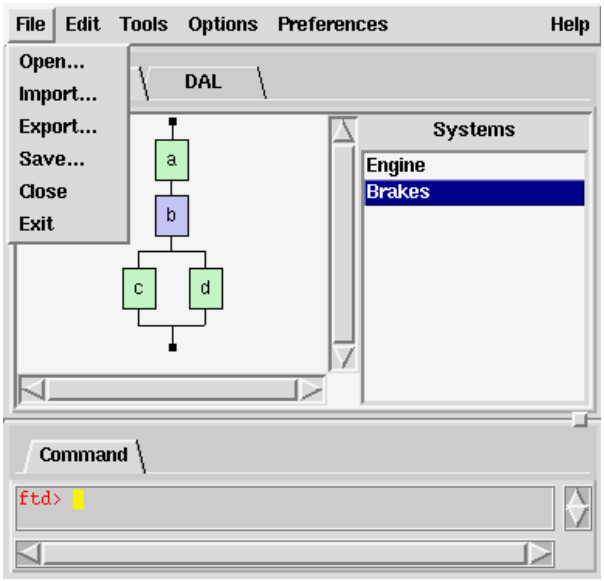

Figure 8. File menu.

4.1 Open

The "Open" command allows the user to open an existing FTD (.ftd) or FTML (.ftml) file. To open a file, the user must select "Open" from the File menu and specify in the dialog box which file to open. To select a file, the user needs to either highlight the file and press OK, or double-click on the file. If a file is already opened when the Open command is invoked, a dialog box will appear asking the user if the current file should be saved before opening another file.

4.2 Import

The "Import" command reads in a list of component names and makes them available to the user when constructing fault trees. The component names should be in a text (.txt) file and separated by whitespace (e.g., a space, tab, or carriage return). To import a list, the user first needs to select "Import" from the File menu and then select the file to import. Once the list is imported, the component names will appear in a drop-down combo box accessible to the user when a new component is created. Figure 9 shows the component dialog box with the drop-down combo box displayed.

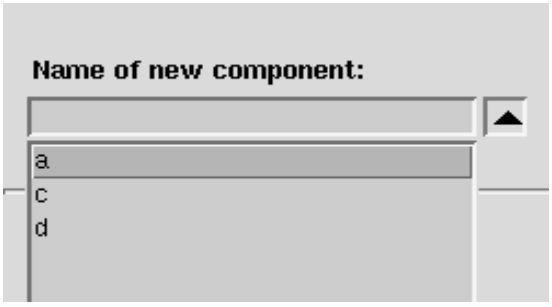

Figure 9. Component dialog box.

Note that if you are using Microsoft Windows 2000, you must type the appropriate file name extensions (for example, .ftd, .pdf, .ftml, .txt) when saving and exporting files. On UNIX and Mac OS X operating systems, the appropriate file extension will automatically be appended to file names if one is not provided.

4.3 Export

The "Export" command exports fault trees to Portable Document Format (PDF) and FTML file formats. This command also exports DALs to tab-delimited text files. To export fault trees or DALs, the user needs to select "Export" from the File menu, enter a file name, select a file type, and press the Save button (see figure 10).

- DAL file – To export a DAL to a file, the user needs to enter the desired file name and ensure that the selected file type is DAL Files (see figure 10). The DAL will be written

to a tab-delimited text file that can be imported into desktop publishing applications such as Microsoft Excel. Note that file names should have a .txt extension.

- PDF file – To export a fault tree to a PDF file, the user needs to enter the desired file name and ensure that the selected file type is Portable Document Format Files (see figure 10). Only the active system will be written to the file. The PDF can be viewed using Adobe Acrobat Reader. It can also be inserted into a Microsoft Word document or PowerPoint presentation. Note that file names need to be saved with a .pdf extension.
- FTML file – To export an FTML file, the user needs to enter the desired file name and ensure that the selected file type is Fault Tree Markup Language Files (see figure 10). Only the active system will be written to the FTML file. Attribute information such as fill color and font style will not be stored. When an FTML file is opened in FTD, the default colors and font style will be displayed. Note that file names need to be saved with an .ftml extension.

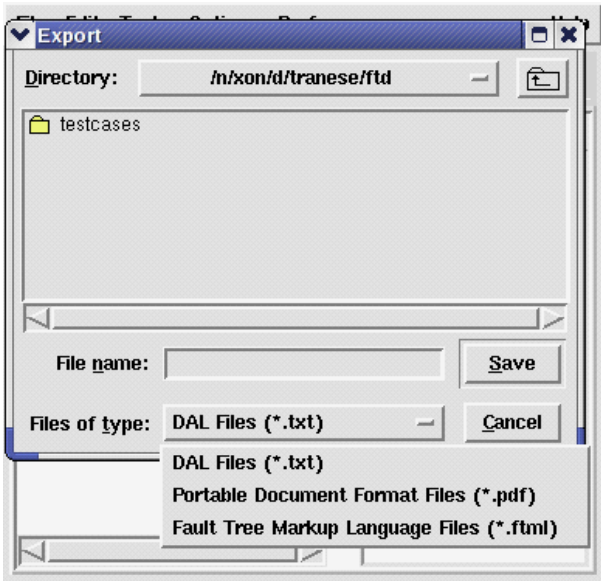

Figure 10. Export dialog box.

4.4 Save

The “Save” command stores all of the systems created in an FTD file. All of the fault trees – including attribute information such as component and system reference names, fill color, and font style – and DALs are stored in this file. The software does not automatically save files, so the user should save his/her work periodically. To save a file, the user needs to select “Save” from the File menu and enter a file name. Note that file names need to be saved with an .ftd extension.

4.5 Close

The “Close” command will close the current file without saving any changes. Only the current file will be closed. The program will not be terminated. To close a file, the user must select “Close” from the File menu.

4.6 Exit

The “Exit” command will terminate the program without saving any changes to the current file. To quit FTD, the user needs to select “Exit” from the File menu.

---

5. Tools Menu

The Tools menu provides the following commands: Go to, Search, Sanity Check, Sysdef, and Sort. These commands are explained in detail in the following sections.

5.1 Go To

The “Go to” command displays a hierarchical view of the current file and allows the user to jump directly to a selected system. To activate this feature, the user must select “Go to” from the Tools menu (shown in figure 11). Initially, a list of all of the systems will be displayed in alphabetical order (see figure 12). To view a complete list of components and system references within a system, the user needs to single-click on the closed folder icon (see figure 13). To make a system the active system from this view, the user must double-click on a system, component, or system reference name.

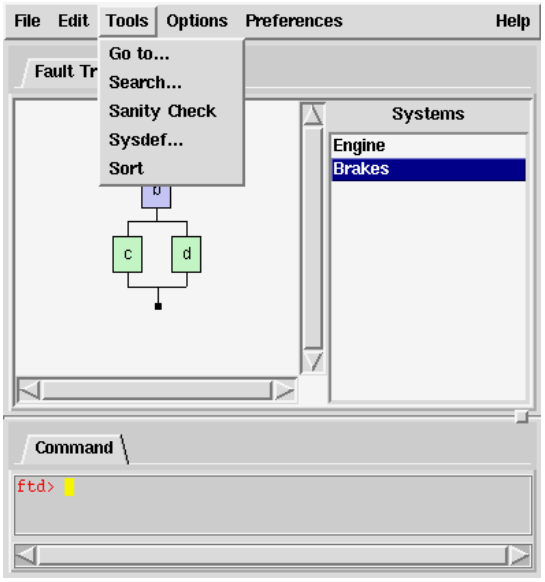

Figure 11. Tools menu.

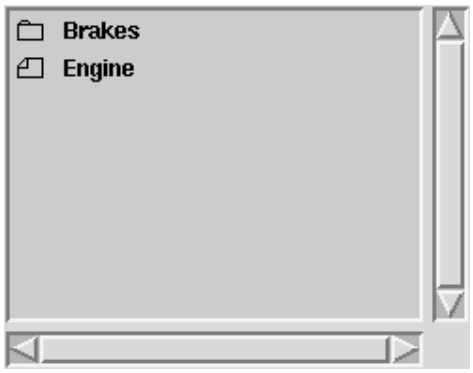

Figure 12. Initial "Go to" list.

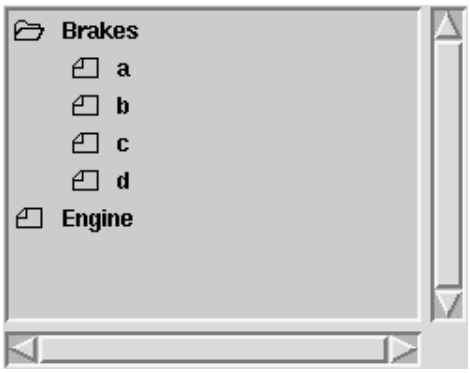

Figure 13. "Go to" list with a system expanded.

5.2 Search

The "Search" command allows the user to search for a specific component or system reference by name. To begin a search, the user must select "Search" from the Tools menu and enter the name or pattern for which to search. This search is case insensitive and uses glob-style matching rules (*, ?, [], and \). If only one match is found, or if there are multiple finds in the same system, the system containing the item(s) will become the active system. If the item is found in more than one system, a list will be displayed. The user needs to double-click on a system name in the list to make it the active system or single-click on the system name and press OK.

5.3 Sanity Check

The "Sanity Check" command performs checks to see if there are any system references that do not have corresponding systems defined in the current file and if any systems do not have corresponding entries in the DAL. To activate this feature, the user must select "Sanity Check" from the Tools menu. After the check is finished, the results will be displayed.

5.4 Sysdef

The "Sysdef" command outputs MUVES system definition code for all of the systems to a text file. To create the system definition file, the user must select "Sysdef" from the Tools menu and enter the desired file name. File names should have a .txt extension.

5.5 Sort

The "Sort" command displays the current list of systems in ascending order. Any systems created after the sort operation has been performed will be displayed in the order in which they were created, not necessarily in alphabetical order. To sort the systems list, the user must select "Sort" from the Tools menu.

6. Options Menu

The Options menu provides viewing options for the utility. These options are explained in detail in the following sections.

6.1 Tcl Command Window

The Tcl command window provides a pane in which Tcl commands can be evaluated. As shown in figure 14, there is a button to enable or disable the Tcl command window. When this button is selected, the Tcl command window will be displayed in the bottom portion of the FTD window. If the box is deselected, the Tcl command window will not be displayed (see figure 15).

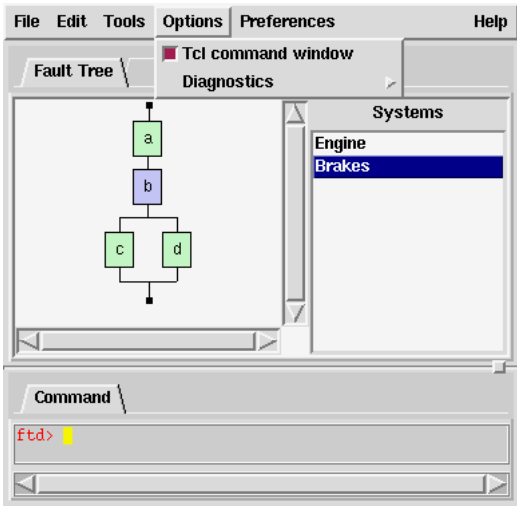

Figure 14. Options menu.

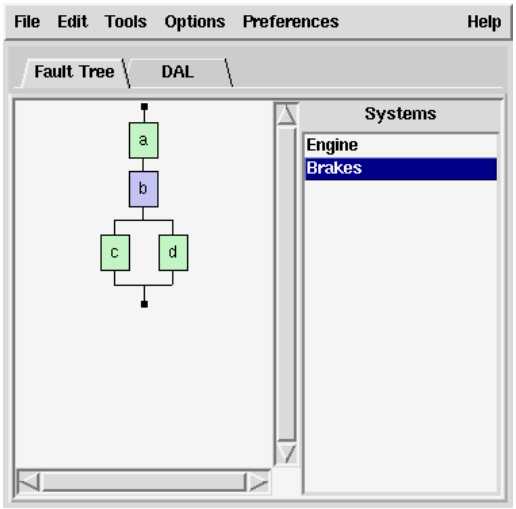

Figure 15. Tcl command window disabled.

6.2 Diagnostics

The “Diagnostics” option prints out run-time diagnostics used by the developers for debugging purposes. To perform diagnostics, the user must select “Diagnostics” from the Options menu and enable the “Reading input files” button from the cascading menu. When a file is opened, run-time messages will be displayed in the console from which FTD was executed.

7. Preferences Menu

At this time, the only preference that can be set relates to the DAL view. This option is beyond the scope of this document.

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